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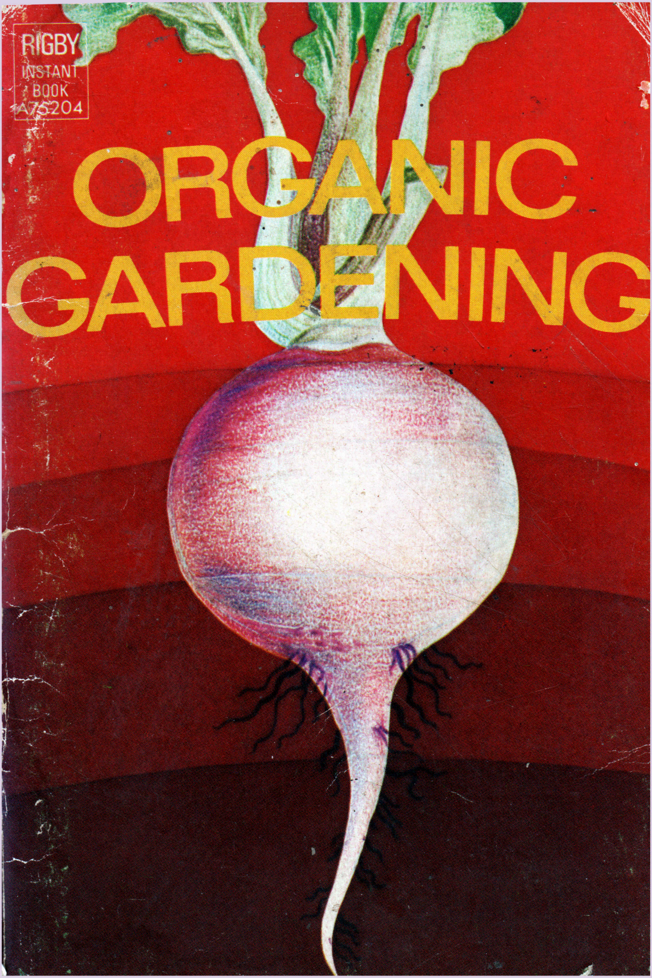
ORGANIC GARDENING



This book has been compiled by Audrey Windram, who wrote the chapters 'Introduction', 'Soil', 'The Gardener's Soil', 'Pests', and 'Weeds'.

The South Australian Branch of the Soil Association helped the author considerably in the preparation of the book; in particular, the former President, Doug McKenzie, and the following member-growers who contributed notes and ideas:

Mrs A. Bubbat:	*'Vegetables'*
Ally Fricker:	*'The Compost Heap', 'Companion Plants', and 'Beneficial Herbs'.*
Peter Grosvenor:	*'Broad Acres Organic Farming'*
Keith Martin:	*'Apples'*
Henry Short:	*'Citrus'*
Peter Windram:	*'Strawberries'*

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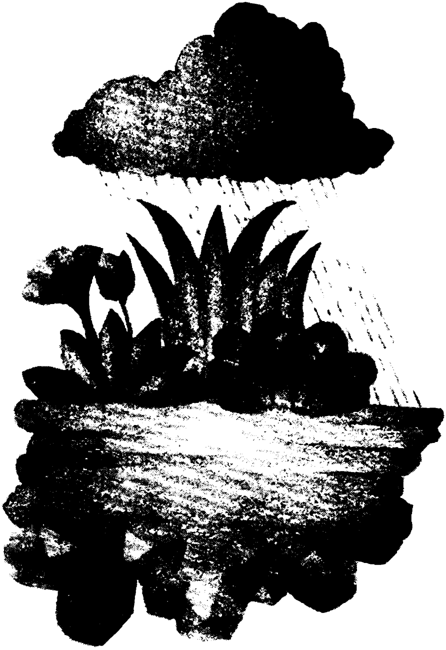
Introduction

Organic agriculture, far from being a modern fad, has been practised for centuries. The communities which have treated their soil with the respect due to a living thing have been able to continue sowing and harvesting the same areas of land for generation after generation. China provides proof of this.

Crops *can* be grown on land which is poor in organic matter, even over a fairly long period, if the soil is continually infused with chemicals; in fact, plants can be grown in water or sand if the right combinations of chemicals are added. There will be no weed problems either.

The organic grower, however, believes there is virtue in working with nature, utilising natural systems and elements, and building fertility with the aid of the micro-organisms which inhabit his humus-rich soil. Though the organic grower may share the orthodox grower's desire that his land should support him, he does not expect it to support him at the cost of ecological destruction. He doesn't want to pollute his land with substances he would be unhappy to feed his children, nor does he want to pollute the waters which flow across it or seep through to other properties or waterways. He doesn't want to kill birds or insects or even slightly poison human beings if he can help it. In particular, he is not in favour of practices which may be dangerous when he can produce good results in his own way—'his own way' being as close to nature as possible.

Soil



'Soil consists of weathered rock' is a statement which is basically sound, but incomplete. Soil involves interaction between:

- inorganic particles of gravel, sand, silt, and clay which originally were weathered from rocks
- organic matter, derived from decayed animal and vegetable remains
- soluble substances which provide mineral nutrients for plant life and are formed in the breaking down of rock particles
- water
- air
- soil microbes which perform their function of soil-building and soil-maintenance, provided that they have sufficient water and oxygen, in which case an increase of organic matter leads to increased soil-life activity and improved fertility.

INORGANIC PARTICLES

Study of the inorganic particles of the soil leads to a study of the parent material of soil—rock.

Rock is not one simple uniform substance. There is a variety of soils upon the earth because of the variety of rocks from which the soil has developed.

The infant earth cooled from gaseous to liquid state, then from

liquid to solid, and in solidifying became what is known as *igneous* rock.

Weathering brought about the disintegration of these rocks. Granules of rock and soil, which by wind, gravitation, and water were deposited, layer upon layer, in low areas, were pressured back to rock. Rocks formed in this way are called *secondary* or *sedimentary*. The strata visible in sedimentary rocks such as shale, limestone, and sandstone reveal the processes which they have undergone.

Metamorphic rocks are those which, through the action of heat and pressure, have chemically changed state. Under such conditions limestone can turn into marble, shale into schist, and sandstone into quartzite.

We tend to simplify things by assigning certain processes to certain eras, but ancient processes are also of the present and future. As an active volcano can still show us the formation of igneous rock from cooled lava, so sedimentary or secondary rock is continually forming as it has been from ancient times.

Minerals

Distributed throughout the rocks of the earth are the many minerals which we have come to regard as essential for industry or farming. Sometimes, as in the case of limestone or dolomite, we utilise the entire substance of the rock for one purpose. In other cases we want to extract thin veins of material locked within the rocks or, by various processes, to extract what we regard as the valuable elements.

The 'crushed rock' or 'mineral fertiliser' manufacturers, often heard of on the organic farming circuit, crush and distribute rock to farmers who believe their soil to be lacking in certain elements. Crushing rock for the sake of its minerals is one way of trying to utilise natural processes by speeding them up and redirecting them a little. Advocates argue with manufacturers of chemical fertilisers that their way is closer to nature and less damaging to the environment than the chemical way, which they claim alters the natural composition of the soil and destroys soil life.

But before entering into such an argument we need to in-

crease our understanding not only of the basic constituents of soil but of the interactions which maintain it.

WEATHERING

Like most of the things we are examining, weathering is just as relevant to today's soil husbandry as it is to the origin of our land forms.

Agents of Weathering

1. Wind, and pitting rain or hail, are abrasive agents.
2. Glaciers and streams also wear away rock.
3. Changes of temperature cause outer rock to expand and contract and ultimately to peel.
4. Water penetrates into rock crevices, where it freezes, expands, and weakens the rock. Water also dissolves some of the binding materials of the rocks.
5. Chemical agents play a part: oxygen oxidises many rock substances, and as many oxides are powdery (iron, for instance, oxidises to rust), these powdery lines in the rocks weaken them; carbon dioxide dissolves in water, forming a weak acid—carbonic acid—which attacks many substances, such as limestone, which will not dissolve in pure water.
6. Plant roots expanding in cracks give forth carbon dioxide.
7. Bacteria which oxidise sulphur and ammonia, thus producing strong acids, are biological agents aiding the chemical warfare upon rocks.
8. The scratching, burrowing, and grazing of animals helps in weathering as does the microbial action encouraged by the presence of their excrement or remains.
9. Undemanding, primitive plant forms, such as mosses and lichens, establish themselves wherever they can upon the rock. These small plants, by root penetration into cracks, can help in the breakdown of rock. Small and primitive plants live successfully off the merest crumbs of rock food and, in dying, leave behind additional nourishment and additional 'biological weathering agents'. So, by degrees, the rock face which harbours a moss or lichen slowly becomes a suitable home for a

hardy tree because each plant form has left behind a residue which will sustain life a little higher than itself.

If we can comprehend that plants, animals, and micro-organisms, when living, can convert dead rock to living soil, and even when dead and decaying can still add to the precious elements of soil life, we are glimpsing the cyclic process of life that keenly concerns us; the process we want to avoid disrupting.

PLANT NUTRIENTS

If these are mentioned while details of rock-formation and weathering are still fresh in our minds we gain a clearer picture of what these nutrients are and how they become available to plants. The importance of interaction between the inert components of soil, and water, air, and soil microbes, then becomes clearer.

It is useful to consider the subject of plant nutrition from a historical point of view. The understanding of plant chemistry was greatly increased in the mid-19th century, when Justus von Liebig, a German scientist, improved techniques of chemical analysis.

It was already thought that carbon, oxygen, and nitrogen came from the air to provide the plant with its most basic essentials. The other nutrients, which analysis showed to be necessary for plant growth, had to come from the soil.

Liebig considered the essential nutrients to be carbon, oxygen, hydrogen, nitrogen, phosphorus, potassium, sodium, magnesium, and calcium. His conclusion was that, in dying, the plant left behind a residue of ash, comprising mineral salts, which then become available to new plant growth. Recent knowledge has lengthened the list of nutrients considered essential, and increased our understanding of plant metabolism, and of the passage of nutrients through the soil to the plant. The order of importance of the nutrients established by Liebig has not been changed.

Considering the nutrients in this order but adding details from

today's knowledge of the occurrence and uses of these nutrients we find that the plant needs:

Carbon, Oxygen, Hydrogen which, in the process of photosynthesis, form *Carbohydrates,* the cellulose, starch, and sugars of the plant. Carbon dioxide from the air, and hydrogen from the soil water, being drawn up by the roots, are the main ingredients in the process; chlorophyll, the green colour pigment of the leaf, is the catalyst; and the sun is the energy source.

Nitrogen to make *Protein,* and as a component of chlorophyll, is provided in a number of ways:

- Rain, especially that of thunderstorms, brings some nitrogen to the soil, both as ammonia and nitric acid, but as great amounts of nitrogen are regularly washed through the soil, the intake through rain is almost cancelled out by the loss through leaching.
- Bacteria which are capable of converting atmospheric nitrogen into compounds suitable for plant growth live in association with the nodules attached to the roots of leguminous plants such as clover, peas, beans, lupins, and the acacia.
- There are also free-living bacteria which can convert nitrogen into protein for their own sustenance.
- There is a type of bacteria which can convert ammonia to nitrogen and another which can do the reverse.
- A very important source of nitrogen is that provided by decomposing cells of all animal life, from the largest down to microbes, and by decomposing animal excrement.
- Nitrogen can be provided by the application of fertilisers such as composts and manures, sulphate of ammonia, urea, ammonium nitrate, and so on. The manufactured fertilisers are by-products of coal and their incorporation into the agricultural scene was part of the industrial and scientific revolution of the last two centuries.

Warning: Some gardeners now doubt whether a great abundance of nitrogen is of real benefit to the soil. The most frequent warnings are:

- plants can be burnt and killed by excessive doses of urea,

either from the commercial product or fresh animal manure too liberally applied;

• nitrate has a harmful effect on blood haemoglobin, as it can change it to methaemoglobin, which is unable to carry oxygen;

• excess nitrogen converts to nitric acid in the soil and the resulting acidity means a drain upon alkalising agents such as potash, lime, magnesium, and soda.

Phosphorus is a non-metallic element upon which plants depend for growth and healthy maturity. Phosphorus is essential for all life, forming the main part of the cell nucleus, and as only a small amount is still being weathered from rocks, there is a need for the remains of living things to be returned to the soil. The growth of cities and the industrial revolution has contributed to depletion of this element from the soil, for corpses and wastes are no longer returned to the soil: deep graves now receive bodies and the seas grow rich in nutrients for which the land hungers.

The work of Sir John Bennet Lawes, an English gentleman farmer, assisted the recognition of phosphorus as an essential nutrient for plant growth, and is an important part of farming and scientific history. Knowing Liebig's theories about plant nutrition, Lawes tried to improve his turnip crop with the application of bone dust (actually a traditional practice even in the 19th century). He knew that the calcium and phosphorus in the bones were essential elements for his crop, but he knew also that these were not soluble in water. Remembering from his chemistry days that sulphuric acid can render calcium phosphate soluble he succeeded, not only in releasing the elements for the nourishment of his turnip crop, but in being instrumental in starting the boom in chemical farming in England. The most abundant source of phosphate proved to be phosphate rock which was treated with sulphuric acid, a by-product of coal. Superphosphate was the commercial result of his experiment.

Potassium, a metallic alkaline element, is food for plants in the form of potassium salts, long referred to as 'potash', and

required by the plant in large quantities to promote healthy growth and to assist in the production of starches. It also acts as a regulator for the amount of water taken up and transpired by the plant.

Rock minerals such as mica, glauconite, and orthoclase are geological sources of potash, while clay is usually rich in potassium.

Sodium, also an alkaline metallic element, as a constituent of common salt, hardly needs to have its value pointed out, though it is more obviously useful to animal than plant life. In arid areas the merging of sodium and chlorine ions, as well as evaporation, can lead to an unwelcome degree of salinity.

Magnesium, also metallic and alkaline, is essential to plants because it is a component of chlorophyll. There are many sources of magnesium:

- About 10 per cent of sea salt is magnesium.
- In Australia magnesium is predominant in almost all subsoils. It is plentiful in clay soils, but sandy soils can show a deficiency.
- Dolomite consists of carbonates of calcium, and magnesium.
- Magnesium is found in association with silica, which is the principal part of quartz and sandstone.
- Talc and Epsom salt are other sources of magnesium.

An excess of magnesium in the topsoil can inhibit the supply of potash to the plant.

Calcium, which forms the cell wall structure in plants, occurs abundantly in gypsum and dolomite.

It had an ancient usage as a curer of leather and an ingredient of cement before it was recognised as an agricultural essential or isolated as an element. Now, however, this alkaline and metallic element, as the chief constituent of limestone, is probably one of the best known of modern fertilising agents, used to counter acidity.

The four elements potassium, sodium, magnesium, and

calcium are not only essential for growth, but also have the power, when dissolved in water, to make that water a conductor of electricity. This knowledge, together with an understanding of the atomic structure of elements, helped to explain how plant nutrients are used (see below).

The list of plant essentials has almost doubled in length since Liebig's time.

Sulphur was found to form part of various proteins.

Iron, manganese, copper, zinc, boron, and **molybdenum** were also found to be necessary in minute quantities. They are not necessary components of the plant, but in a variety of ways they are needed for the growth processes.

- Iron, for instance, though not a component of chlorophyll, is necessary for its formation.
- Manganese has a similar use.
- Zinc and copper are oxidising agents which help form various essential substances.
- Boron and molybdenum are thought to regulate intake of nitrogen and other elements.

Experimental work showed that plants would suffer if any of these elements were missing, and also that the comparative proportions of the elements were important. Some elements could inhibit the uptake of others, and in a wrongly balanced soil environment, unwanted elements could rise to toxic proportions.

HOW PLANTS TAKE UP NUTRIENTS

The study of electricity led to the understanding of how nutrients travel about the soil, either to our advantage or our disadvantage, and also how plants can take up ions (charged particles) of necessary elements. Plants do not take up compounds for their life-building processes; they take up ions of the elements.

Some elements become available just by being dissolved (that is, decomposed) in water; others need to be dissolved in a weak acid; others again need an alkaline solution. Phosphorus, the ingredient that started the whole chemical farming revolution, dissolves in sulphuric acid, but it also has a habit of re-

verting back to an insoluble substance; hence the necessity for such great application of superphosphate.

Osmosis

To say that the nutrients are 'dissolved in water' seems a simple way of describing how the plant drinks up its necessities from the soil. Nutrients dissolved in soil water are reduced to their elements and the ability of the hair roots to take up this solution depends upon the process of osmosis. The diffusion of soil solution into the plant root occurs when the root solution is more concentrated than the soil solution.

Capillary action draws the moisture upwards once it is in the plant. The cohesion of water molecules helps this water rise upwards, as does the fact that the vessels through which the moisture travels are very narrow.

Photosynthesis, the starch-and-sugar-manufacturing process will also play its part in this capillary action and, finally, so will **transpiration.**

All these interconnected processes will require **sun energy** to complete the cyclic pattern of plant nutrition.

Though all is not yet known about feeding and the taking up of nutrients, a variety of observations has provided much knowledge. Each plant takes up nutrients according to its needs, not according to abundance in the soil, though poisoning and deficiency disease will occur in an unsatisfactory environment.

Ion exchange Cation and anion exchange (cations and anions are the positive and negative ions of an element) is the means by which ions are transferred from soil to plant—or for that matter often lost from plant or topsoil. Hydrogen ions are prominent in these exchanges, and roots excrete hydrogen in exchange for the desired elements of plant growth. Once within the plant the waterways are used for the transference of ions throughout the plant.

THE IMPORTANCE OF ORGANIC FARMING

One might be justified in asking how plants flourished, and agriculture proceeded, before Liebig and his fellow scientists started their experiments. The success of natural farming was more likely before the rise of cities; before the starvation of the land of all that should have been returned to it—bones and plant ashes and excrement with all their precious 'salts', that had been 'borrowed' for life.

The flaws that have become apparent in chemical farming are the result of imbalance. Plant necessities were discovered by the observation of the effects of deficiencies in the soil. These 'deficiencies', however, were sometimes more apparent than real; often, in the artificially boosted soil environment, the trace elements, and even the major elements, were being inhibited.

Suppose we really believe in organic farming, because it makes good healthy sense; or assume that because production of so many of these chemicals is dependent upon coal and other now short-supplied commodities, they might vanish from the market; or we feel concern about the squandering of fossil fuels and other energy resources where they are not strictly needed; or suppose we care about re-establishing a natural environment which is not in danger from chemicals—how do we induce what we have regarded as nutrient-poor soil to produce? What will be our aids if they are not manufactured chemicals?

The Soil is a Chemical Laboratory

The way in which insoluble substances decompose without the aid of manufactured chemicals can only be understood by giving thought to the fact that the soil itself is a great chemical laboratory with many significant agents:

- The bacteria which make carbonic acid—as in fact roots themselves have power to do.
- Bacteria which convert sulphur to sulphuric acid and can decompose phosphate rock.
- Hydrogen which forms a very potent acid for decomposition and is also very active in ionic exchange.

• Bacteria which oxidise iron and magnesium.
• Earthworms travel from subsoil to topsoil bringing forth particles which they have digested and which now, as elemental ions, are available to plants. The topsoil becomes a little deeper while this is going on.
• Mycorrhizal fungus lives out its life in symbiotic association with certain plants, feeding off substances those plants must dispose of in order to remain healthy.

We use the term 'organic farming', but it is necessary to remember that plants absorb their mineral nutrients as inorganic particles. From organic materials such as dead plants, animals, and excrement, the soil organisms manufacture the elements from which these living things were built up. The process is continuous and cyclic: an elaborate building up of molecules and life forms and a breaking down again to elements from which life can again be built.

Certainly things will proceed slowly, but for the sake of balance, this is a good thing. It may be necessary for the bank manager to insist on quick returns for a cash crop, so he can see a prompt dividend on his bank's money, but the environment does not profit from haste.

The Gardener's Soil

SOIL PROFILES

What soil is basically, has already been stated, but the gardener will be concerned besides with questions about his particular soil; whether it is sand, loam, clay, or part and part; whether it is hilly or rocky, wooded, or flat and bare; whether it is of good structure for root penetration and moisture absorption without water-logging; and to what extent he can enhance its virtues and minimise its faults.

Because of the organic grower's nature consciousness, he will probably already have been noticing neighbourhood signs. Earth cuttings, if there are any about, will already have told him something of the local soil profile. Though in some areas, particularly in the hills, soil can vary considerably from one hectare to another, generalisations can still be helpful. Is the locality limestone country; or iron-stained clay, upon a rock base; or loam lying many metres deep in rich alluvial country? How do the layers in the profile lie? Is the topsoil shallow? The subsoil deep? The rock base close to the surface? How good is the natural drainage?

Roots will not be able to penetrate unweathered rock that lies close to the surface. Water-logged conditions will also be air-excluding conditions. Limestone country will have special capabilities and limitations quite different from those of heavy

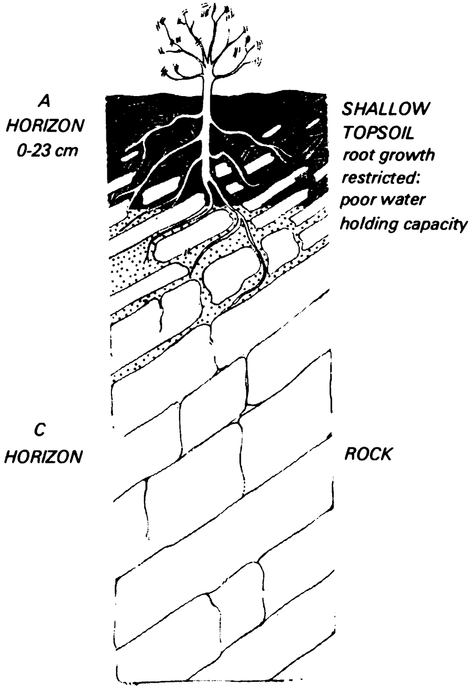

A
HORIZON
0-23 cm
SHALLOW
TOPSOIL
root growth
restricted:
poor water
holding capacity
C
HORIZON
ROCK

Figure 1

clay. The kind of vegetation natural to the area, and that which has been successfully introduced to it, will be of interest. The wildlife will also be of interest to the gardener who intends to co-habit with it.

The top of a cutting will provide a vantage point for seeing naturally manufactured compost. Though a more dense production can be observed at the foot of the trees, where the earth has been cut away it is easier to see how the dead growth has been slowly incorporated into the soil in layers, dried and whole at the surface, and more decomposed with each layer. The penetration of the humus into the soil can be seen in the soil profile. Sometimes the subsoil will be stained quite some distance from the surface with humus that has been leached down, or carried down by soil life, so that the profile will show up as a thin dark layer, a lighter wider layer, a further humus-stained layer, and eventually the impermeable base of the parent material.

There is no absolute necessity for a gardener to dig a pit in the area he wishes to cultivate, but should a pit be dug for any purpose it can provide useful information about the sub-structure of the soil.

The three main layers in soil—the topsoil, subsoil, and parent material—are called the A, B, and C horizons by soil scientists. In the soil represented in Figure 1, because of age and limited rainfall, the B horizon has not developed. The shallow topsoil cannot store much water, and the rock directly beneath it restricts root growth.

In Figure 2, the topsoil and subsoil layers are deep and of good structure, making the C horizon relatively unimportant. Such a soil will have a good reserve of minerals, will be capable of storing large amounts of moisture, and will allow unrestricted plant growth.

SOIL TEXTURE

Handling the soil will tell much about how it holds moisture.

- A very heavy soil will be squelchy and sticky when thoroughly wet, and hard-baked when dry.
- Sand will not cohere; its grains will remain separate.

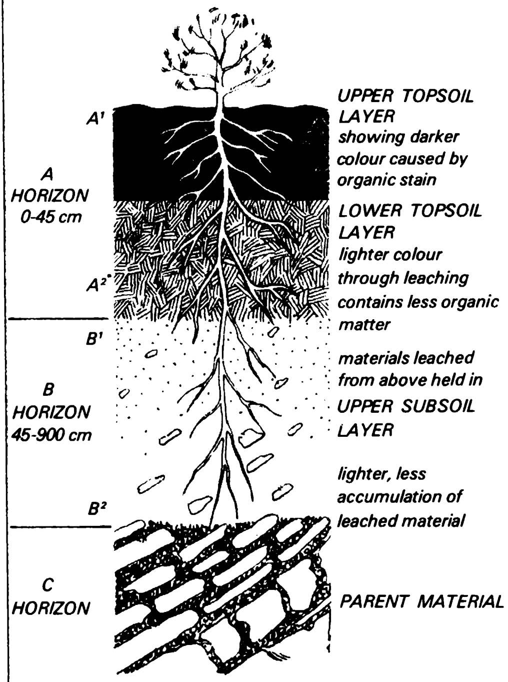

A¹
A
HORIZON
0-45 cm
A²
B¹
B
HORIZON
45-900 cm
B²
C
HORIZON
UPPER TOPSOIL
LAYER
showing darker
colour caused by
organic stain
LOWER TOPSOIL
LAYER
lighter colour
through leaching
contains less organic
matter
materials leached
from above held in
UPPER SUBSOIL
LAYER
lighter, less
accumulation of
leached material
PARENT MATERIAL

Figure 2

• A good crumbly loam will come together in a soft, rather spongy ball when moulded in the cup of the hand, and part again into its large-crumbed structure when rubbed. It is neither prone to sogginess, nor hard-baking, nor does it permit water to bypass its granules, without adequately moistening them.

• Topsoil, walked upon and handled, will behave in a characteristic manner, and it is soon easy to differentiate between a lively soil and one that is in need of restructuring.

It is possible for a patient gardener to provide bulk and heaviness to sand, or a more friable texture to clay. If he is gardening in a small area and it is convenient, he can add some heavy soil to sand or sand to very heavy soil—but either type of soil will be improved by the addition of compost materials.

The texture of clay might also be improved by a liming agent such as gypsum, dolomite, or lime, but the almost automatic habit of 'liming', irrespective of true soil requirements, is little more than a fetish, and the necessity for such application has been exaggerated.

SOIL ACIDITY

Liming is carried out to change the soil pH from acid to a more alkaline condition. Often this procedure inhibits the action of trace elements in a clay soil that is not really short of these elements. Zinc and manganese deficiencies have been caused by such liming. Some gardeners prefer to apply coarse dolomite rather than powdered limestone, as it does not alter the soil condition so greatly.

To presume that the soil needs lime may not be as dangerous as other presumptions which end in the application of chemicals, but it is just one instance of the unquestioning acceptance of gardening habits which we have been persuaded are so much more scientific, efficient, and professional than the slower-moving habit of observation and cautious trial and error that a gardener who has some faith in his own intelligence will follow. None of this is intended to deny that certain crops have certain nutritional requirements. It is caution against gullibility and presumption.

IMPORTANT CONSIDERATIONS

• Hang on to what you have. Don't, for instance, let a horror of, or embarrassment about, weeds cause you to denude a land of all vegetation at a time and place when it is likely to be vulnerable to erosion. Wind will carry away light soil very easily if it is exposed; given a chance, running water will gouge out the heaviest clay. Growing plants are the best defence against erosion. Even plant wastes laid upon the land will help to prevent the soil from being carried off, as well as providing nutrients for the soil.

• Build your soil, don't deplete it. The topsoil is the area where the gardener has most influence for good or ill, and it is here that he should expend his efforts to increase fertility. It is gratifying to start with a few centimetres of topsoil over clay, or poor stony ground, and year by year see the dark friable layer deepening with humus: or in the case of sand, to see the inert cream or grey grains being incorporated with the organic composts lavished on it.

In a topsoil in which soil life is active, the deeper mineral wealth of the subsoil becomes more easily available. Micro-organisms and worms move more freely through a rich and friable soil, and so they digest and bring to the surface the nutrition from lower levels. At the same time, topsoil depth is increased. Such soils are affected less by the leaching of minerals than badly structured soils.

• Don't doctor soil unless you know exactly what you are trying to achieve, and try to bring about any changes using the most natural methods possible. Remember that compost and animal manures are rich in many trace elements as well as nitrogen. But even here a discriminating hand is needed, as heavily applied raw animal manure can be too high in nitrogen for the health of plant or animal, while a sudden application of straw will rob the soil of nitrogen.

• Don't cart off wealth by taking plant residues elsewhere. Every crop has fed from your soil and depleted it of essential elements —give these back with interest if you want succeeding crops to flourish. Repeated cultivation, especially of virgin and unimproved soil, breaks down the soil structure by destroying organic matter.

The results of this can be seen in an overworked and underfed soil where the soil grains have been pulverised and many carried downwards or eroded away. The pores of the soil below the surface become clogged and the soil is badly in need of rejuvenation.

- It is possible to make mistakes with any methods but in non-chemical methods mistakes are more easily rectified because of the natural processes of organic decomposition.

The Compost Heap

Organic matter is a many-sided blessing to the soil, since it is not just a sponge to hold water and air, but is also a larder of nutrients. For organic matter to provide most benefit to the soil, it must be made available to the soil in conditions that favour its conversion to *humus*. Humus is no longer organic matter, but it is not yet soil; it is a substance produced in the transition of organic matter to soil, and is valuable in itself.

Organic matter can be incorporated straight into the soil and left to decompose, or it can be composted first.

The procedure for composting which follows is one reliable method. There are many variations built upon the same principles, and the choice for most people will depend on the availability of waste materials. It is logical to use what is readily available with as wide a variety as can be arranged—even the variety of using some materials dry and some green is useful.

Animal manures are valuable but organic farming organisations warn that drug residues are likely to be found in manures from intensive animal husbandry units.

THE SITE

The site for the compost yard should be well drained, preferably slightly sloping, and sheltered by a mixture of evergreen and deciduous shrubs. Elder trees (cuttings of which

may be hard to obtain) and birch trees growing nearby benefit the composting process, but the compost piles should not be closer than 2 metres to the trunks of trees.

The site chosen for the compost should be cleared of any weeds and lightly turned over to facilitate movement of micro-organisms. It is a good idea to use the same composting sites continuously so that a good population of the necessary bacteria will build up beneath them.

SIZE OF THE HEAP

The heap should be at least 1 metre in width, height, and length. Ideally, width should be 1.5 metres to 2 metres and height 1.5 metres, with the heap as long as space and materials permit. Let the sides of the heap slope at about 45° and shape the top with a shallow depression to preserve heat and moisture.

In most Australian conditions the compost heap should not be made in a trench or walled off in any way. It is essential to keep air circulating around the heap as much as possible.

COMPOSITION OF THE HEAP

The proportionate mixture of raw materials is 20 per cent manure and 10 per cent soil with 70 per cent green matter—straw, weeds, vegetable scraps, and lawn clippings.

The greater the variety of materials used the better, as long as they are free from harmful additives and chemicals. Chopping, shredding, and mixing the raw materials together with the soil, rather than building the heap in layers, will result in a more even distribution of air and moisture through the whole mass. The first layer of the heap should be made from very coarse dry material, such as rods of bamboo and dried brush, to aid aeration.

It will almost certainly be necessary to sprinkle the raw materials with water as you build the heap. The heap should feel like a wrung-out sponge, and must not be dripping with water. Cover the heap with straw and soil to conserve the moisture in it.

Although a thoroughly mixed heap is desirable, many people build their compost heap in layers so as to keep the proportions right. The layers consist of a 15-centimetre layer of green

material, weeds, lawn clippings, leaves, and refuse, a 5-centimetre layer of manure, and then a sprinkling of soil. This order is then repeated over and over again. The coarsest materials should be placed in the centre of the heap together with any undesirable weeds. Any roots and weeds with soil still mixed in them should have the soil end placed on the outer edge of the heap to add to the outer covering layer of soil. If it is necessary to add lime, add the lime or dolomite with the sprinkling of soil. Add wood ash in the same way.

Air holes are usually made by driving a garden stake through the heap from top to bottom.

MAINTAINING THE COMPOST HEAP

A compost heap in which the raw materials have not been chopped into small pieces will take from three to six months to decompose, depending on the nature of the raw materials and climatic conditions. It may be necessary to turn the heap once or several times before it has decomposed completely. If the odour from the heap is unpleasant, and/or if the heap is too wet and compacted, it will need turning. When it has been turned, the inside of the compost heap goes to the outside and the outside becomes the centre.

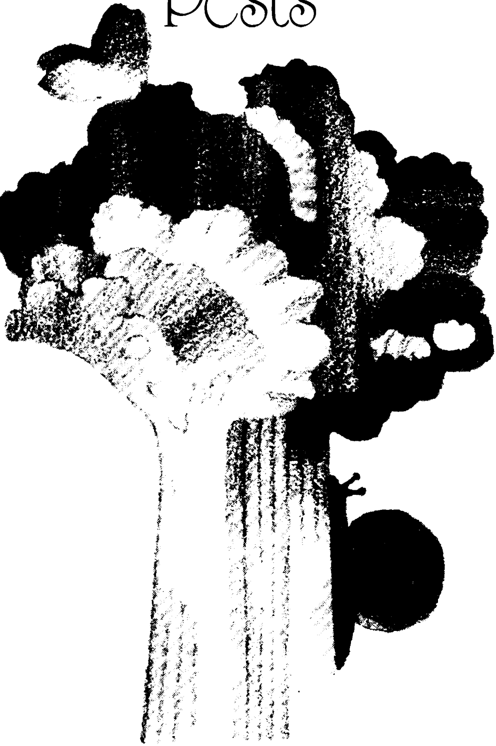
Temperature peak in a heap is usually reached within the first few days and then will gradually drop off to a temperature just slightly higher than that of the environment.

When the heap is complete it should be dark brown to black in colour, be crumbly in texture, and have a pleasant odour. The structure of the original materials should be gone. Sometimes bits of straw or weed stems retain their outer form but they will crumble readily between your fingers.

Suburban compost clubs would provide a useful and friendly way of gaining a mixture of materials in a short time: each member could take a turn at having the heap built at his house. In this way, much could be learnt of the composting process, and at the same time refuse could be disposed of to advantage.

In some municipalities, councils are already aware of the good sense of composting and have installed large-scale composters.

Pests



The organic grower is usually asked two questions, and the first is 'What about pests?'

If the inquirer wants to hear a long reply, the grower can explain the philosophy that prompted him to organic growing in the first place, but usually a quick answer is wanted. A sample of produce presented to the inquirer with, 'These resisted them' is usually considered a poor answer—though it should be considered the best. 'They usually go away' sounds so naive it will not be believed, and 'We can spare a few for the pests' will be taken as proof that organic farming is a farce and a failure.

The inquirer who is used to consulting the neat tables laid out in pest-control brochures feels that you are side-stepping when you answer him with a philosophy—or even the undamaged produce.

It is surprising how many pests do go away if restraint is employed in the first place. Once the warfare starts, one pest will become more numerous as another is eliminated. This phenomenon has kept the chemical industry busy since it first introduced the 'miracle' of D.D.T., which was highly effective in the control of Codlin-Moth, especially in apple and pear orchards. Unfortunately the small wasp *Aphelinus mali,* formerly the controller of Woolly Apple-aphid, fell victim to the spray and Woolly Aphid became established in practically every apple orchard. The Two-spotted Mite or Red Spider is another pest whose nuisance

value has increased remarkably because its predators have been destroyed. The Mite presents even more problems because of its capacity to develop resistance quickly. These are just samples of problems that occur with chemical controls, and the reader may already be familiar with them. Most sprays are also lethal to bees, many to fish—and their effects on non-economic species have not been researched.

A grower who holds a philosophy about organic farming will respond to problems and search for solutions in such a way that the answer he comes up with will be life-sustaining in the broadest sense. Without this philosophy, discussion has to be conducted not only on a strictly economic basis, but on a very short-term economic basis: it will centre on the cost of and profit from *this* crop production; there will be no assessment of soil fertility loss or gain; no assessment of the economic loss involved in destroying predators.

For those who want them the Departments of Agriculture print extensive lists giving instructions for the control of crop pests. In these it is possible to discover which sprays have a long toxicity period and which have short ones. Generally chemicals of low persistence and low cumulative danger are most highly toxic. This is highly valuable from a commercial point of view but can be a serious cause of wildlife deaths.

It may be of interest to list chemicals in rough categories as the topic is so much in vogue. There are three main groups of modern insecticides: organochlorine products, organophosphorus, and carbamates.

Organochlorine: These have generally high persistence and fairly low toxicity and they present residue problems. They are: D.D.T, B.H.C. (Lindane), methoxychlor, T.D.E., Dieldrin, Aldrin, endrin, heptachlor, Chlordane. The last five are the most highly residual.

Organophosphorus: Parathion, maldison (Malathion), azinphos ethyl, trichlorphon (Dipterex), dimethoate (Rogor), Imidan, diazinon are among this second group. They are more toxic but have short persistence.

Carbamates: Carbaryl (Sevin). New products are being developed in this group. It is less toxic and less persistent than many of the first named but has a high toxicity to bees.

ACCEPTABLE PEST CONTROL

A short list of insecticides is issued by the Standards Committee of the Organic Food Movement in South Australia. This has been based on British Soil Association Standards.

Names of other organisations likely to assist are given on page 2.

Insecticides

These should be avoided wherever possible, and should be

confined to certain products of vegetable origin which are tolerated by warm-blooded animals when used with care. Some of these are:

Derris	Ryania
Pyrethrum	Quassia
Nicotine	Herbal sprays

Even such sprays can be borderline cases. Nicotine, for example, if not very carefully used is toxic to earthworms; derris should not be used if there is danger of its getting into water as it is toxic to fish.

Prohibited: All insecticides that are persistent or cumulative, in particular chlorinated hydrocarbons. No questionable herbicides are to be used by registered 'Organic Growers'.

Fungicides

These should not be used *except where absolutely necessary.* When any such fungicides are used they should not be applied at such a late stage as to risk leaving a deposit on any fruit or vegetable to be sold as organically grown. Mercurial fungicides and other fungicides of similar toxicity should not be used.

Such terms as 'absolutely necessary' and 'of similar toxicity' are ambiguous. This problem is dealt with by the advisory service provided by the organisation and also by the grading system which informs the consumer whether the produce has been grown without the aid of any chemical under completely organic conditions, or to what degree this state of perfection has been modified. The result is an encouragement for all growers to strive towards the production of non-toxic and highly nutritious food.

The best advice is 'observe'. What you find in your garden, how it affects what grows in your garden, how you react to what is there, how the entire ecology of your garden evolves, will depend far more upon your way of looking at things than upon cautions, recommendations, or tables.

The variation in insect names from place to place can cause confusion but with the recommended blanket remedies all are taken care of and so confusion hardly matters! I would be

prepared to believe that insects such as the Harlequin Bug need eradication, except that in the years we have found them in our garden we have not been able to discover the harm they do. We know the damage slugs cause but it occurs over such a brief span of time compared to total cropping time that it does not appear sensible to damage the ecology on their behalf, and with this restraint predators or later dry conditions keep their numbers down to a reasonable level.

Weeds

'What about weeds?' is the next question put to the organic grower, who will often answer: 'How do you define weeds?' or 'I like weeds'. Perhaps you have interested the questioner sufficiently so that he really does want to hear your thoughts about weeds.

Weeds are those plants the gardener doesn't want—so one man's weeds may be another's fodder, or even kitchen vegetable. To some the native vegetation has a value that is almost sacred; to others it is rubbish to be removed. Our attitude to the plant, or our ability to use it, determines its status: 'plant' or 'weed'.

The organic grower is usually even less worried about weeds than about pests. He digs them in, or mulches with them, or makes compost of them; in fact he will even beg more weeds from his neighbours and cart them home. He is happy if they seed and sprout anew so that he can have more weeds to do the same again.

When land has been acquired for a growing project, often a bulldozer or plough, or both, are hired to denude it of vegetation when the new owner has barely looked at it. It is sensible to study growth before removing it. In the first place it tells much about the capabilities of soil. Soil grows as prolific a variety of plants as it can maintain. We should start our agricultural plan-

ning by noticing what kind of life is maintained there before we decide what kind of a garden we want to make.

If the land is scrub, it is almost certain to be harbouring insectivorous birds which will be allies to the grower if he doesn't destroy their habitat completely. Bushland has the ability to maintain life to a degree that we have not even begun to understand. Some at least needs to be retained. The practice of removing native vegetation in preparation for agricultural efforts to follow—especially if they are a long time following—can result in much destruction. Ecological damage and soil erosion result and the weed-hater is likely to have a far more noxious collection of weeds encroaching upon his land than those he has removed.

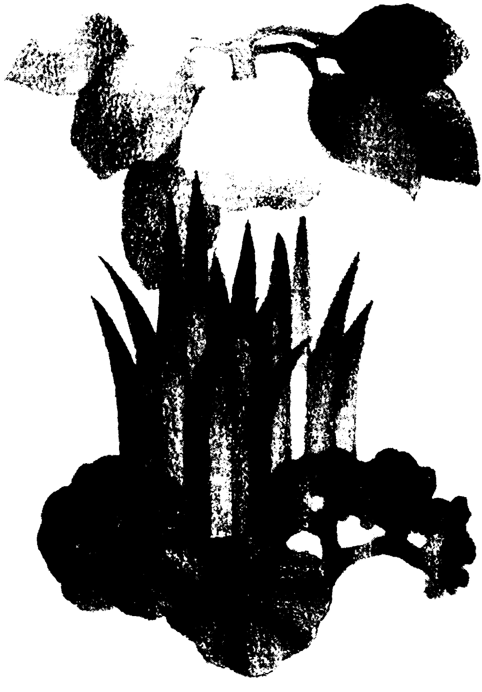
A slope that lies fallow throughout the winter needs the cover of vegetation that will appear on it as a guard against erosion. A commercial crop may be a prettier sight than a crop of weeds, but a crop of weeds is a much better sight than land that is gashed with erosion scars.

A strawberry crop which bears a cover of weeds during the winter months, is none the worse when the weeds are removed in early spring. It is possible that the weeds act in the same way as the snow in cold countries, forming a blanket to protect the seeds and bulbs and hardy plants that lie in the ground.

Many growers of fruit trees who keep the ground cover find that the soil then harbours a teeming life of micro-organisms which supply an adequate amount of nitrogen and minerals to their crops. The cover may be cut for composting purposes but not ploughed under.

Certain weeds are considered a particular problem to certain growers and eradication may have to be reverted to, but the methods usually prescribed often fail dismally. Blackberries can be a great trouble, but an area which is kept under cultivation has far less trouble with this 'weed' than that which receives its yearly spraying of hormone weedkiller and no further attention. The same comment would apply to other unwanted plants.

Companion Plants



The following list of companion plants has been compiled as a result of the experiments of many growers. A caution should be given regarding any possible confusion between names which could vary from state to state and from country to country. The list is still evolving. The results of every grower's experiments are worth sharing.

PLANT	BENEFITS IN ASSOCIATION WITH	DISLIKES
Apple Trees	Chives against Scab. Nasturtium repels Woolly Aphis. Wallflower.	Potatoes. (Don't store apples with carrots or potatoes)
Asparagus	Tomatoes. Parsley. Mulch with seaweed.	
Beans	Carrots and cauliflower inter-planted. Cucumbers—use beans as a border. Plants of winter savory are beneficial. Corn.	Onion, garlic, early potatoes, fennel, gladiolus
Dwarf Beans	Cabbages, winter savory. Celery and cucumbers.	
Broad Beans	Corn. Intercrops with spinach. Early potatoes.	
Cabbage, Cauliflower, Broccoli, Sprouts, Kale	Early potatoes. Aided by dill, camomile, sage, wormwood, lad's love, rosemary, pennyroyal, peppermint, and spearmint. (Cabbage Moth is repelled by tomatoes, sage, rosemary, hyssop, thyme, mint, wormwood, lad's love.)	Strawberries

Carrots	Lettuce and chives. (Onions, leeks, rosemary, wormwood, and sage repel Carrot Fly.) Aided by dill in early stages, but dill must be removed before it flowers.	Being stored with apples
Cauliflower	Celery.	
Celeriac	Leeks (alternate rows), scarlet runner beans.	
Celery	Leeks, tomatoes, bush beans (1-6 plants).	
Citrus Trees	Guava tree.	
Corn	Potatoes, beans and peas, melons, squash, pumpkin, cucumber.	
Cucumbers	Corn (alternate rows), chives, oregano, marjoram, early potatoes, early cabbage. A few radish seeds repel beetles. Border with beans.	
Eggplant	Beans.	
Fruit Trees	Nettles, garlic, chives, tansy, horseradish, lad's love, nasturtiums.	
Gooseberry	Tomatoes.	
Grape Vines	Elm trees, mulberry, hyssop, tansy.	
Kohlrabi	Beet, onions.	Tomatoes, climbing beans
Leeks	Celery, celeriac, carrots.	

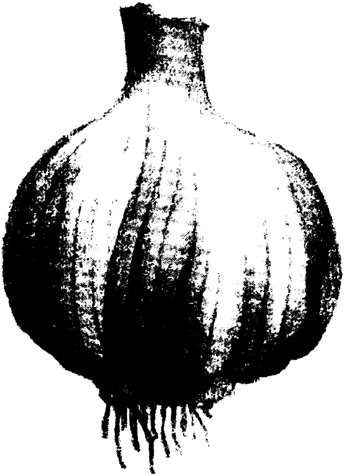
PLANT	BENEFITS IN ASSOCIATION WITH	DISLIKES
Lettuce	Strawberries, carrots, radish, chervil.	
Melons	Radish.	
Onions	Camomile (1 plant to 4 metres).	
Peas	Radish, carrots, cucumbers, sweetcorn, beans, turnips. Alternate rows with early potatoes.	Onions
Potatoes	Beans, corn, cabbage, peas, broad beans, nasturtiums, eggplant.	Sunflowers, tomatoes
Pumpkin	Corn.	
Radish	Peas, lettuce, chervil, hyssop, cucumbers, nasturtium.	
Raspberry		Potatoes and blackberries
Roses	Garlic, chives, parsley, lupins, mignonette.	
Spinach	Strawberries.	
Strawberries	Beans, lettuce, spinach, borage, pyrethrum.	Cabbages
Tomatoes	Asparagus, parsley, basil, early cabbage, French marigolds, nettles, nasturtium.	Potatoes, kohlrabi, fennel
Turnips	Peas.	Mustard

Beneficial Herbs

BASIL	Keeps diseases and pests from tomatoes; flies and mosquitoes from outdoor eating areas. A potted plant or dried leaves will drive flies and mosquitoes out of the house. An annual. Sow seeds in October when the ground is warm. Very frost-tender, and won't grow near rue.
CAMOMILE	Likes being walked upon. Keeps other plants healthy. If placed near a sickly plant there is a 90 per cent chance of recovery.
CHIVES	Beneficial throughout the garden and orchard, except near peas and beans. Keeps aphis from roses.
ELDER TREE	Bruised leaves are offensive to most insects. Worn on a hat or rubbed on the face will prevent flies and mosquitoes from settling on you. A decoction of young leaves sprinkled over delicate plants and buds will kill aphids and small caterpillars.

FENNEL Disliked by fleas. Grow near kennels or stables. Powdered leaves or seeds sprinkled about will also drive away flies.

GARLIC As for **Chives.**



BLACK HOREHOUND Will kill flies if put into fresh milk and placed in an area where they are troublesome.

LAD'S LOVE Repellent to most insects. A wet sprig rubbed on the face will deter flies. Protects cabbages from White Cabbage Moth and fruit trees from pests.

MARIGOLDS	Repel beetles and discourage eelworms when planted among vegetables and flowers.
MINTS	
Catmint	Rats dislike it. Valuable as a screen for crops or near beans. Good in conjunction with hyssop as a border.
Pennyroyal	Plant near cabbages. Disliked by insects. Drives fleas away from kennels.
Peppermint Spearmint	Disliked by rats, mice, and flies. Plant near cabbages to keep them healthy and free from pests.
OREGANO	Keeps beetles away from cucumbers.
RUE	Very offensive to garden pests. A few leaves will drive ants and flies out of a house and will kill flies. Leaves are curative for poultry.
TANSY	Discourages beetles, ants, aphids, and flies. Plant throughout garden and near house to keep out ants and flies. Dried leaves act as a safe insecticide in the house. Very effective if mixed with elder leaves.

Growers' Ideas

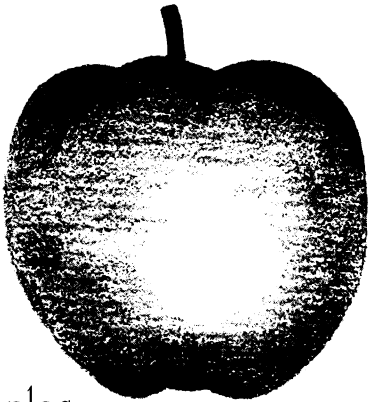
The organic grower is never keen on mono-cropping—the practice of using the same land for the same crop for successive years—as this tends to encourage diseases and pests. Commercial orchardists and vignerons usually have no choice—they have to specialise, even though a varied crop would be healthier. They must, therefore, be on guard against ravages to the crop.

The organic grower knows that any form of agriculture is an alteration to nature and so he tries to increase his understanding and lessen the amount of ecological damage that his alterations and interference cause. A good manager can rectify some of the damage of careless predecessors.

The growers' tales which follow are written in a variety of styles and present a variety of ideas. There may be some repetitions or contradictions, but these chapters, written by people solving problems of organic growing in their own ways, are intended to provoke thought, rather than produce an effect of tidiness and conformity. The collection does not attempt to represent a full range of crops.

Comments from an agricultural expert follow the growers' section. Again, for tidiness, his comments could have been used to make corrections to the texts and so give an impression of unanimity. But this impression would be misleading, as gardeners do not agree about everything. The grower tends to

write—correctly I believe—of conditions as he finds them on his own property; while the agricultural expert, with the experience of a wider range of properties and conditions, draws a more cautious generalisation suitable for a wider application. I hope that the presentation of diverse ideas, followed by an expert's comments, will encourage growers and potential growers to realise what a personal thing their own garden is, but to see that its enjoyment and efficiency may be improved by using the experience of others who are busy with theirs.



apples

To grow apples under organic conditions means that the methods applied to every operation involved in apple growing must be organic or 'nearest to nature'.

The four main operations are soil treatment; pest and disease control; pruning; and irrigation.

Soil Treatment

This is by far the most important aspect of organic farming and the aim is to produce a soil with a high content of organic matter. Such soil becomes actively populated with soil organisms of all types: mould, fungi, and bacteria—all of which aid in breaking down organic matter. The breaking-down process produces humus and makes plant food available to growing crops in a balanced form. It gives the soil the capacity to absorb and retain needed moisture, drain excess moisture, resist erosion, and produce healthy plants. Soil may be made to attain the condition described by the application of compost, well-rotted animal or poultry manure, hay, mulch, and so on.

In apple production these materials may be applied to the soil surface, preferably in autumn; and the grass allowed to grow through it until spring, when the grass is mown, allowed to lie, and eventually broken down by soil processes. Further mowing should be carried out during spring and summer to reduce the demands on soil moisture.

The use of weed-killers is not an acceptable practice to the organic grower. The application of toxic materials to the soil is antagonistic to natural processes and may have a detrimental long-term effect.

Pests and Diseases

The main aim of the organic grower is to produce relatively undamaged fruit of good quality without the use of poisonous chemicals.

Codlin-Moth makes this difficult and even impossible in some areas at present. All the insecticides in common use against Codlin-Moth are toxic to predators such as Stetherus (small ladybird) and Lacewings, and the loss of these useful insects allows pests like Red-spider Mites to flourish unchecked unless another toxic material is applied by the grower to control them. So the vicious circle is established. Techniques are available to alleviate this situation, mainly involving the use of insecticides in greatly reduced amounts and less frequent applications. The suc-

cess of this practice depends on knowing exactly when a flight of Codlin-Moths will emerge.

Lure pots—glass jars containing a mixture of eight parts water to one part molasses—are hung in the centre of some trees, preferably in Codlin trouble-spots. This solution attracts the moth and some are trapped on the surface, to be discovered when the grower makes his daily inspection.

Once the emergence of the moths has been established, a very light application of insecticides the following evening or night, directed at the upper parts of the tree, will ensure a good kill with a minimum of contamination of fruit and environment. This is in contrast with the standard practice of constantly keeping on trees and fruit a cover of insecticide sufficient to destroy the pest whenever it does emerge.

Six or more full-strength sprays are applied in standard practice, while in the lure-pot method two or three sprays at quarter-strength can give adequate control and allow survival of some useful predators.

Pyrethrum, a comparatively harmless insecticide, can be used successfully under favourable conditions but close observation and exact timing are essential for success.

Fungus diseases can also be treated with comparatively harmless material with reasonable success.

Copper and lime sulphur sprays will control Apple Scab (Black Spot) and Powdery Mildew, the two most troublesome apple diseases. These two materials are less toxic than many of the newer fungicides, and do not contaminate the tree or the fruit.

Pruning

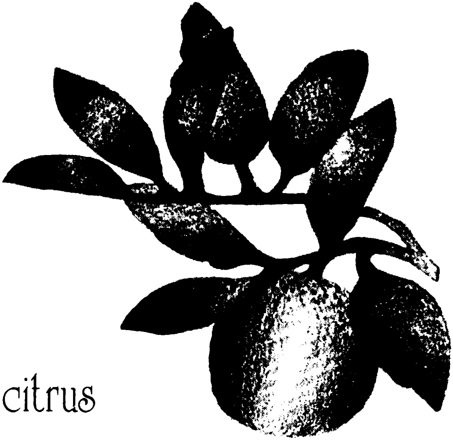
This operation is always the subject of contention but it will not greatly affect the quality of fruit unless it is much too severe. As a general principle, cuts made should allow the tree to follow its natural pattern as closely as possible.

Irrigation

When irrigation is necessary it is best applied by the method nearest to nature's, and for apple orchards overhead sprinklers,

used preferably in the evening or at night, are most natural. Sprinklers under the tree are a satisfactory substitute if the water used causes damage to tree foliage. Furrow and trickle methods are designed to place the water in what is called the 'root zone', and it is claimed that they give better results with less water. In the short term this may be so, but concentration of water under each tree is decidedly unnatural, and the ecology of the whole orchard area must benefit from a rain-like application of water.

A useful principle for the organic grower is that where a choice of methods exists for any operation, the one nearest to nature's method is always the safest and in the long term, usually the most effective.



citrus

Soil Treatment

Citrus needs a light, well-drained soil. If chemical fertilisers are

used to boost plant growth, earthworms are killed and the symptoms of an infertile soil are concealed. When organic matter is not replaced, the humus is depleted, thus disrupting natural bacterial activity. The end result of these harmful factors is that the soil packs down hard and movement of air and water through the soil is prevented. This situation encourages the formation of fungi, which rot the roots and finally kill the tree. The organic system, on the other hand, encourages earthworms, increases bacterial activity, and opens up the soil. Thus heavier types of soil are practical under organic agriculture.

Cultivation is not necessary, but trees appear to suffer temporarily after the change-over from cultivation to no-cultivation.

It is not practical to achieve weed control by mulching, as the area to be covered is too great. The ideal appears to be the formation of permanent leguminous cover crops which are mowed to keep moisture up-take at a minimum and provide mulch.

The mulch is supplemented with compost. Raw materials are either sheet composted; that is, spread straight on the ground and allowed to rot into the soil; or composted in heaps, which makes it possible for natural minerals to be added to the compost to correct mineral deficiencies and soil pH. Choice of method is dependent on raw materials available, but with either method, flies will breed if raw materials are used incorrectly.

Economic factors must play an important part in the choice of materials for composting; because of the labour cost involved in making compost in heaps, it is desirable that the raw material be obtained free of cost. The type of material available determines the method to be used and also the additives that will be needed: for example, lime may be needed to neutralise acids.

The presence of earthworms in the soil is most important, especially in the non-cultivation system. They aerate the soil, carry vegetable material down into it, and bring up to the surface minerals that have been leached out of the root zone.

Diseases

In wetter areas the most troublesome disease of citrus is the fungus disease—Brown Rot—which comes from the soil. The

non-cultivation method appears to keep it under control by preventing the spores contained in the soil from being splashed on leaves in wet weather, or carried by dust when the soil is dry.

Pests

Harmful insects are kept in balance by predators, provided that panic action, namely the application of insecticides, is not taken when things get a little out of balance. Ants will cause a serious upset to the balance and appear to need controlling. Methods being investigated are the use of herbs such as tansy, and the banding of trees with a sticky material. Bands round trunks of trees prevent ants from climbing into trees—provided that lower limbs are kept clear of the ground.

strawberries

Soil Treatment

Strawberries thrive in well-manured or composted ground. Prepare the soil by digging deeply, then adding compost or compost materials. Deep litter from poultry or other animal sheds is excellent material. Deep litter which is a mixture of sawdust and manure, seaweed and manure, straw and manure, or a similar combination, can keep the plants well fed for the three to four years they are likely to be harvested. Sawdust provides some acidity to the soil, depending on how new it is, but strawberries are not harmed by a degree of acidity. If, however, the litter is applied immediately before planting, the plants suffer, as the soil organisms are busily engaged in breaking down the sawdust, and the plants are temporarily robbed of nitrogen. Nitrogen is available to the plant from new manure, but standards committees which govern most organic outlets frown upon gross feeding to plants from raw manure, as they believe the result is injurious to health—especially kidney health.

Ideally then, materials are thoroughly composted before application to the soil, or an interval of time is allowed to elapse between soil preparation and planting, so that the crop is not eaten until twelve months after the application of raw manure. Never expect satisfactory soil texture or good distribution of moisture unless fibrous matter is part of the composting material.

One controversial point has arisen out of the use of broiler-shed litter: broilers are birds produced under intensive care for the meat industry and are often fed antibiotics, to reduce losses caused by infection; the manure, straw, and so on, from their sheds, may be chemically contaminated. Stable manure offers a high degree of safety as horse-owners usually are not indiscriminate in the use of chemicals or drugs.

The object of composting is to produce the deep humus-rich loam which strawberries thrive on. A north-easterly slope is ideal for us but strawberries are seen thriving as well in some well-managed seaside gardens as in the hills—especially if, as well as having compost-rich soil, these have been pampered with a mulch of seaweed from which the salt has been washed. Our crop thrives in a moderately cool hills climate.

Cultivation

We prepare mounds, making them run across the hill to avoid wastage of water in summer and erosion in winter. The hoeing which precedes this preparation is also carried out across the hill.

We make our beds a metre wide and about 15 centimetres high. After we have trimmed the plant roots down to about 10 centimetres in length we plant them 38 centimetres apart, two rows to our 1-metre mounds.

Early June is considered the appropriate planting time, but we have had interesting results from summer planting. This involves buying the plants in winter and keeping them in cold storage until late December. Weather conditions and other factors can cause heavy losses with this method, but the vigour of the remaining plants has been such that we are able to fill the gaps with good runners from these and we get a first season's crop as heavy as a second season's normally would be.

Cleaning-up time involves weeding, combined with levelling the pathway and returning soil to the mounds where needed, thinning out runners, and mulching. Mulching with straw, seaweed, or other suitable fibrous vegetable matter is good practice as, when this material has decayed to the point where a new mulch is needed, the old mulch is beneficially incorporated into the soil as additional humus.

When planting a succeeding crop we place it in an area as far away as possible from the preceding crop.

Pests and Diseases

We don't use any artificial fertilisers, or insecticides or fungicides. The slugs which appear at the beginning of the season soon vanish, because of some ecological adjustment we don't fully understand—perhaps drier conditions as the season warms up, perhaps birds which find harbour in our surrounding scrub. Whether or not we understand this balance, we have learnt to depend upon its asserting itself and so we refrain from running to the poison pack. We don't spray for mould even when conditions are right to encourage it. Those who do spray, seem to have no less trouble with mould, and I often wonder what they

count as the benefit, or if they have heard of the beneficial fungus of mycorrhiza which is no doubt as susceptible to the fungicides as mould. We don't leave mouldy fruit to harbour more mould but remove it when picking.

vegetables

FIRST GROWER
Soil Treatment

When we bought this place it had no topsoil at all. It had been a piggery and the pigs had eaten not only all vegetation, but the topsoil as well. The topsoil now is what we have built ourselves by making compost, in heaps and in the ground.

As we keep poultry, with straw as the basis of the deep litter for the hens, our composting is based on this deep litter. In ad-

dition to this, we use soil, dolomite, weeds, newspapers, and anything else suitable that comes to hand for our compost heaps. We dig out about 30 centimetres of soil and start the heap in this, using the soil that has been dug out to form thin layers between the other ingredients.

When we compost the deep litter straight into the soil we do it by spreading it on the ploughed paddock, then hoeing it in lightly and planting a crop of peas or rye. This in turn is hoed in and then the site is planted with vegetables.

We make most use of the prepared compost when we are in a hurry. The ground is hoed and then furrowed, with furrows the appropriate distance apart. We put the compost into these furrows and plant straight into the prepared compost.

I also have an old 4-gallon drum with the base cut out placed 15 to 30 centimetres into the ground. I put all kitchen scraps in here and keep it covered with soil, so that it gives off no smell and does not attract flies, and it provides more good compost.

I would never plant carrots in poor soil. This vegetable is best planted straight into the compost furrows. Cabbages and other brassicas are given a side dressing of good compost as well.

Pests and Diseases

Our plants are very healthy and not damaged by pests. I keep the cabbages free from Cabbage Moth with a mixture of sour milk, wheat flour, and squeezed garlic. With a spoon I put this, in very small amounts, into the centre of each cabbage. This year I am going to add a bit of egg to the mixture to make it sticky—we get a number of broken eggs and I can sensibly use this. Tomato blight has given me some trouble and if this continues I will use Bordeaux mixture against it.

Companion planting seems to help to keep all other pests and diseases under control. We put radishes between the cabbages, nasturtiums next to cucumber, and African marigolds, the source of pyrethrum, next to celery. When growing celery, we do not use the blanching methods which give white stalks, because this method of growing keeps the sun off the plant, and consequently it has almost no vitamin A.

My interest in organic gardening results from an interest in health. I cannot throw away carrot tops or other valuable food when I know how many vitamins and minerals they contain—they go into the stew or stockpot.

Time of Planting

This is important for all vegetables. I rear my seedlings in a glass-house, but I am particular about when I plant them out. If I put a whole tomato in the open ground in the autumn the time when the seedlings appear is the right time for planting tomato seedlings. Using the same method with other vegetables I make my own planting calendar. This is of more use to me than the information in books because not only each state but each area has a different seasonal time for plants.

SECOND GROWER

Soil Treatment and Cultivation

- Brassicas such as cabbages, cauliflowers, and sprouts, are very heavy nitrogen feeders and are first to be planted in the heavily-composted plot; tomatoes, capsicums, cucumber, and pumpkin can follow. Root vegetables will do well in the soil following these. After a spell and a further heavy composting the cycle can start again, so that the land is not used too soon for the same crop in succeeding years.
- In hot weather, seeds should go straight into the permanent beds whenever possible. Lettuce and beetroot especially will appreciate not being set back by summer transplanting.
- Wood ashes make a good side dressing for such plants as celery and celeriac.
- We slash our weeds and plough them in, and we take great care and pride in building our compost heaps, as this is the way to create living soil.

Pests and Diseases

- Black or green aphids will vanish from plants with a good squirting with the hose.

• Camomile is so useful as a companion plant anywhere that it is often called 'doctor of the garden'. Nettles are also good.
• If I have to revert to any sprays they are pyrethrum, derris dust, and nicotine but we love our ladybirds, our bees, our birds, and our worms too much to destroy these by using anything stronger or even using these if we can help it. Healthy plants don't develop as many troubles as sickly ones.

broad acres organic farming

About fifteen years ago it seemed advisable to convert to organic farming because members of the family were persistently sick with asthma and too many animals were suffering from unexplained ills. It seemed likely that our methods of farming could be the source of ill-health in both humans and animals.

Soil Treatment

Some of our land is typical of the poorest in the state and some ranks with the best, but the difference in production is not marked. All areas can be brought into useful production by the right methods. What the right methods are, is dictated by the quality of the virgin soil. Most soils have ample minerals, and the farmer's task is to make these available by biological methods — to increase the soil life.

I had not realised before how greatly cultivation can affect the soil—either for better or for worse. For instance, I use the chisel plough a lot, but do not dig a poor soil deeply.

Clearing Land

When preparing an area of virgin or neglected property, the first task is to move a proportion of natural scrub, bearing in mind ecological factors. If possible, I would retain about 10 per cent of scrub, leaving it accessible to cattle, as it provides value to the diet in the form of minerals, vitamins, and antibiotics. The feeling for natural balance has to be strong in the farmer. It is possible to make a living and still hold to ecological principles. It is not possible to lay down rules for such management: concern and vigilance will enable each farmer either to maintain an ecology as balanced as that which he started with, or to create a better one.

Establishing Pasture

After removing the trees, the task is to establish pasture. This should consist of as many deep-rooted plants of pasture species as possible. All of these play their part in making minerals from various depths available to plants. It also provides a wider range of choice for animals, which, given the opportunity, have the ability to select according to the needs of good health.

Especially with poor soil, do not risk destroying topsoil. All available organic matter must be utilised in the soil. In some cases it may be necessary to add minerals in crude form, that is, as crushed rock.

The pioneer pasture must be one that can tolerate a low-

fertility soil, but gradually, higher quality and more demanding pasture can be planted. (The term 'higher quality' is a contentious one. Too many valuable plants, because they are hardy, are not properly recognised for their nutritional worth.)

The pasture I use is always based on legumes—in my case, clover. This provides essential nitrogen to the soil. The grazing animal soon adds additional nutrition to the soil by way of excreta, and the cycle is soon working to profitable advantage. Where most of the land is poor, this gradual build-up of pasture can be achieved by a slow overall upgrading of the pasture as the soil improves and is able to maintain such growth.

In other instances a smaller area will be brought to a higher fertility by bringing in cheap suitable compost material. It is also effective to bring in hay for animals, so that animals and introduced vegetable matter lift the fertility of the initial area. Then this area is either expanded outward from its perimeter—the new pasture spreading outward, its fertility added to by the excretion of the animals; or one paddock may be brought to high fertility and then another, development of the second and succeeding ones being supported to some degree by the profitability of the first.

Advantages of Organic Farming

As you can see, the organic farmer is not a man in a hurry. It takes time to make such improvements. Economically he is at an advantage, because his outlay is small and, if his management is good, he is able to support himself without the overdrafts necessary for the farmer who must develop large areas rapidly. It is particularly over a long period that the advantages of the organic farmer can be seen financially, but also in soil fertility.

Grazing animals remove very little mineral from the soil. What they do remove is easily recovered by organic methods—the indigenous supply in the soil increasing the amount of minerals available.

I am adamant about two things. One is that it is economical to farm organically, and the other is that animal health benefits from these methods, which means that human health, dependent upon the animals, is also improved.

FOOTNOTES FROM AN AGRICULTURAL ADVISER

• *Irrigation of apples and other crops* Be cautious with overhead watering unless the water is of good quality. Salinity in the water can make this practice hazardous because of the extra evaporation and consequent concentration of salts. Such water can, however, be used without damage if row or sub-surface irrigation is used.

• *The vegetable grower's* suggestion for determining seed germination time is soundly based but two provisos should be added.

1 Each season is different—germination is triggered by temperature, and humidity and moisture.

2 Each variety of, say, tomato, may have different needs—hence one may germinate earlier than another. Nevertheless, this is an excellent way of determining the earliest times at which seed may germinate in a district.

• *The broad acres farmer's philosophy* seems to me basically sound but I disagree that scrub should be grazed by cattle. In my experience this will lead to destruction of the scrub in time. Perhaps the answer is planned shelter-belt planting, fenced at least to control grazing of scrub, but preferably to prevent it.

Although most soils have ample minerals, this generalisation does not apply to South Australian soils, many of which lack essential minerals.

• *Husbanding resources* In view of pending world shortages we should husband our fertiliser reserves for use on those areas which are naturally lacking in reserves: trace elements for the upper South-East of South Australia would be an example.

Since the industrial revolution, farming has grown to depend almost completely upon energy fuels for use in fertilisers, herbicides, insecticides, petrol, oil, gas, and electricity. The internal

combustion engine and a whole host of aids have made farming a capital-intensive operation, with the energy input being provided by fossil fuels. This cannot continue. There must be a husbanding of resources, in place of the present wastage and abuse of the ecology.

Because of necessity as well as inclination, the peasant farmer—the organic grower—the small family farmlet—may well be about to re-enter the agricultural scene.

Here are some other INSTANT BOOKS in this series:

C73140	*Hints for Young Homemakers*
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C73150	*Fish Cookery*
C73151	*Continental Fish Cookery*
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Organic gardening is not a modern fad but has been practised for centuries. The organic grower works with nature, earning his living from the land, but not at the cost of ecological destruction.

Here, growers committed to organic methods share their knowledge and experience with anyone who is concerned about the depletion of the earth's resources by conventional growing methods.

● understanding the soil ● establishing the compost heap ● coping with pests and weeds ● using companion plants and herbs ● how to grow various crops ● comments from an agricultural adviser